INSTRUCTION MANUAL

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TYPE 1232-A, -AP
TUNED AMPLIFIER AND NULL DETECTOR

AND

TYPE 1240-A, -AP
BRIDGE OSCILLATOR-DETECTOR

GENERAL RADIO COMPANY

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INSTRUCTION MANUAL

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TYPE 1240-A, -AP BRIDGE OSCILLATOR-DETECTOR

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GENERAL RADIO COMPANY
WEST CONCORD, MASSACHUSETTS, USA

SPECIFICATIONS

TYPE 1232-A TUNED AMPLIFIER AND NULL DETECTOR

Frequency Response:

Tunable Filters – 20 c/s to 20 kc/s in 3 ranges; between 2% and 6% bandwidth to 10 kc/s; 2nd harmonic at least 34 dB down from peak, 3rd at least 40 dB down; rejection filter on two highest ranges reduces 60-cycle level to at least 60 dB below peak (50 dB at 50 c/s). Dial accuracy is ±3%.

50- and 100-kc Filters – 2nd harmonic 44 and 53 dB down, respectively.

Flat Response – ±3 dB 20 c/s to 100 kc/s.

Sensitivity: See plot. Typically 0.1 μV over most of the frequency range.

Noise Level Referred to Input: See Figure 6. Noise figure at 1 kc/s is less than 2 dB at an optimum source impedance of 27 kΩ.

Noise Level Referred to Output: Less than 5 mV on FLAT filter-frequency position, minimum gain setting, and -20 DB switch position; less than 50 mV in MAX SENS position.

Input Impedance: Approximately 50 kΩ at maximum gain, varies inversely with gain to 1 MΩ at minimum gain.

Maximum Safe Input Voltage: 200 V ac or 400 V dc.

Voltage Gain: 120 dB on the tunable ranges; 100 dB, flat range; 10[illegible] dB at 50 kc/s; 100 dB at 100-kc position.

Output: 1 V into 10,000 Ω. Internal impedance is 3000 Ω.

Meter Linearity: DB differences are accurate to ±5% ±0.1 division for input of less than 0.3 V.

Compression (on LOG position): Reduces full-scale sensitivity by 40 dB. Does not affect bottom 20% of scale.

20-dB Position: Reduces gain by 20 dB in linear mode.

Distortion (in FLAT position): Less than 5% (from meter rectifiers).

Power Supply: 12 V dc, from 9 mercury (M72) cells in series. Estimated battery life is 1500 hours. Optionally, a rechargeable battery (non-mercury) can be supplied on special order.

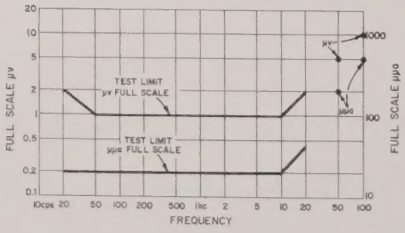
Terminals: Input, GR874 Coaxial Connector; output, binding posts.

Dimensions: Width 8 in (205 mm); height 6 in (155); depth 7½ (190 mm).

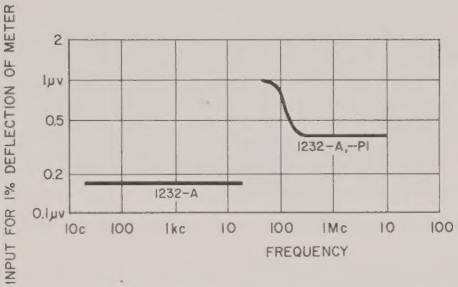
Net Weight: 5¾ lb (2.7 kg).

Shipping Weight: 8 lb (3.7 kg).

General Radio Experimenter reference: July 1961, June 1964, June 1965.



Minimum input for full-scale meter deflection as a function of frequency.



Sensitivity and frequency range of Type 1232-A.

TYPE 1232-P1 RF MIXER

(Accessory not supplied)

Frequency Range: 70 kc/s to 10 Mc/s. (Can be used up to 60 Mc/s, with care in the selection and identification of local-oscillator frequencies). Recommended local oscillators for the 70-kc to 0.5-Mc and the 0.5- to 10-Mc ranges are Type 1210-C and Type 1211-C, respectively.

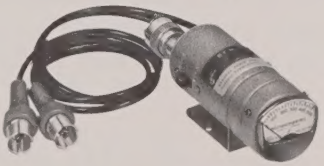
I-F Output Frequencies: Switch-selected to 20 kc/s or 100 kc/s.

Bandwidth: 0.8 kc/s in 20-kc position, 10 kc/s in 100-kc position with a 20 kΩ output load (Type 1232-P1 RF Mixer alone).

Sensitivity: See plot.

Input Impedance: Approximately 200 Ω.

Output Impedance: Approximately 20,000 Ω.



Dimensions: Diamenter 2¼, length 6¾ in (58, 175 mm).

Net Weight: 1 lb (0.5 kg).

Shipping Weight: 3 lb (1.4 kg).

General Radio Experimenter reference: December, 1963.

U. S. Patent No. 2,548,457 and D 187,740.

TYPE 1232-P2 PREAMPLIFIER

(Accessory supplied with Type 1232-AP and Type 1240-AP only)

Input Impedance: Greater than 100 MΩ in parallel with 70 pF.

Output Impedance: 10 kΩ.

Voltage Gain: Approximately 0.7.

Noise Referred to Input: When the Preamplifier is connected to a Type 1232-A Tuned Amplifier and Null Detector set to 100 Hz selective, the equivalent noise generatofs at the input are:

Open-circuit noise < 0.1 μμA

Short-circuit noise < 0.3 μV.

Optimum Source Impedance: 3 MΩ.

TYPE 1240-A, -AP BRIDGE OSCILLATOR- DETECTORS

The Type 1240-A Bridge Oscillator-Detector is a rigid assembly of a Type 1311 Audio Oscillator and a Type 1232 Tuned Amplifier and Null Detector. The Type 1240-AP includes the Type 1232-P2 Preamplifier in addition to the above instruments. These compact assemblies are convenient for use with audio-frequency bridges and other null-balance devices.

The units are secured with a Type 480-P316 Adaptor Plate Set and bolted together near the rear of the instruments. The assembly fits a standard 19-inch relay rack. For bench use, the two wings of the relay-rack adaptor set can be removed and the four rubber feet can be installed in the corners of the oscillator-detector assembly.

Supplied with the Type 1240-A or Type 1240-AP Bridge Oscillator-Detector are a Type 874-C58A Panel Connector, a Type CAP-22 Power Cord, and spare fuses. Operating instructions for the Type 1232-A or -AP Tuned Amplifier and Null Detector are given in this book. A separate instruction book is supplied for the Type 1311 Audio Oscillator.

NOTE

Separate detailed instructions are furnished for the Type 1311 and the Type 1232-P2 as required.

Type 1240-AP Bridge Oscillator-Detector fitted for rack mounting.

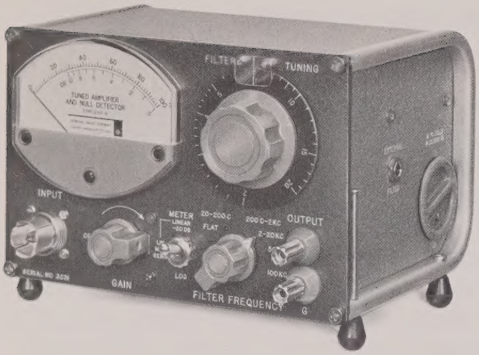


Figure 1. Type 1232-A Tuned Amplifier and Null Detector.

Section 1
INTRODUCTION

1.1 PURPOSE.

The Type 1232-A Tuned Amplifier and Null Detector (Figure 1) is a sensitive, low-noise amplifier continuously tunable from 20 cps to 20 kc, with additional fixed-tuned frequencies of 50 kc and 100 kc. Intended primarily as a bridge detector, the Type 1232-A can also be used as a detector of high-frequency modulated signals (with a crystal demodulator), a wave analyzer at audio frequencies, and a preamplifier for transducers. It is usable to 10 Mc by addition of Type 1232-P1 RF Mixer.

The Type 1232-P2 Preamplifier can be added to improve the signal-to-noise ratio and consequently the effective sensitivity of the Type 1232-A when the latter is to be driven by very high (greater than 100 kΩ) impedance sources.

1.2 DESCRIPTION.

The Type 1232-A consists of a low-noise preamplifier, a frequency-selective stage (feedback amplifier and null network), an amplifier-compressor stage, and a meter-rectifier circuit (see block diagram, Figure 2). The total gain of the amplifier is about 120 db. Full-scale meter sensitivity is 1 microvolt or better over most of the frequency range.

With the Type 1632-A Inductance Bridge, this null detector permits inductance balances to a resolution of 1 part in 10^6. Comparable precision for capacitance balance can be obtained with the Type 1615-A

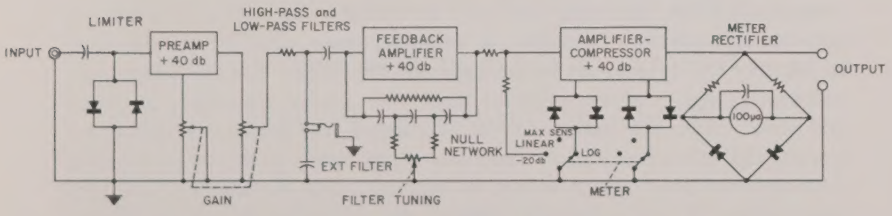


Figure 2. Functional diagram of the null detector.

and 716-C Capacitance Bridges. Useful also as a null detector for r-f bridges such as the Types 916-AL and 1606-A (to 10 Mc) with Type 1232-P1 RF Mixer accessory.

The amplifier is powered by 12 volts dc, supplied by nine mercury batteries in series. The output is 1 volt into 10,000 ohms.

Front mountings are extendible to tilt instrument face.

The Type 1232-P2 Preamplifier is a detachable accessory that consists of a low-noise field-effect transistor used in common-source configuration. Power for the preamp is provided by the B+ supply of the Type 1232-A.

1.3 CONTROLS AND CONNECTORS OF THE TYPES 1232 AND 1232-P2.

TABLE 1

	Name	*Type*	*Function*
Type 1232	FILTER TUNING	Continuous rotary control	Tunes filter within selected tuning range.
	FILTER FREQUENCY	6-position rotary switch	Selects desired frequency characteristic; tuning-frequency range of 20-200 cps, 200 cps-2 kc, or 2-20 kc; flat, 50-kc or 100-kc response.
	GAIN	Rotary control	Turns instrument on or off and controls gain.
	METER	3-position toggle switch	Selects full-gain linear, -20-db linear, or logarithmic response.
	INPUT	GR874 Locking Coaxial Connector	Input terminals.
	OUTPUT	Pair of Type 938 Binding Posts	Output terminals.
	EXTERNAL FILTER	Phone jack	Connection for external filter.
Type 1232-P2	HIGH Z, LOW Z	Toggle switch	Determines whether Preamplifier is included in input to Type 1232 (HIGH Z) or shunted (LOW Z).
	INPUT	GR874 Connector and Cable Assembly	Input terminals.
	OUTPUT	GR874 Connector and Cable Assembly	Output terminals (to be applied to INPUT of Type 1232).

1.4 USE OF EXTERNAL FILTERS.

Filters can be connected at the EXTERNAL FILTER jack. When a telephone plug is inserted in this jack, the built-in shunt filter is disconnected. The external filter may be either a series-tuned circuit to trap out an undesired frequency or an antiresonant parallel-tuned circuit to improve the selectivity at the desired frequency. For the purpose of calculating the Q of the external filter, the source impedance is about 700 ohms. Since the external filter is plugged into the circuit at a point beyond the 60-cps rejection filter and where there is 80-db gain to the meter circuit, it is important that the external filter be shielded and preferably that it use a toroidal inductor for minimum sensitivity to hum pickup.

Section 2
PRINCIPLES OF OPERATION

2.1 PREAMPLIFIER OF THE TYPE 1232-A.

The preamplifier stage of the Type 1232-A Tuned Amplifier and Null Detector is designed to minimize noise from both low-impedance sources, such as inductance bridges at low frequencies, and high-impedance sources, such as capacitance bridges at low frequencies.[1] A transistor with a noise figure of 3 to 5 db at an optimum source impedance of 50 kilohms is used. By use of negative feedback, the input impedance of the preamplifier is also made 50 kilohms, and the noise level indicated on the output meter is relatively constant and independent of source impedance.

The input transistor is protected from possible damage due to large overloads by a limiter consisting of a series capacitor and two shunt silicon rectifier diodes. This circuit effectively prevents signals greater than 1 volt, peak-to-peak, from reaching the input transistor and does not contribute noise or distortion to low-level signals.

Maximum gain of the preamplifier is about 40 db, which is adequate to swamp the noise of succeeding stages. After preamplification, the signal passes through a set of series and shunt filters, which are designed to reject frequencies above and below the selected tuning range. Typical filter characteristics are shown in Figure 3. On all switch po-

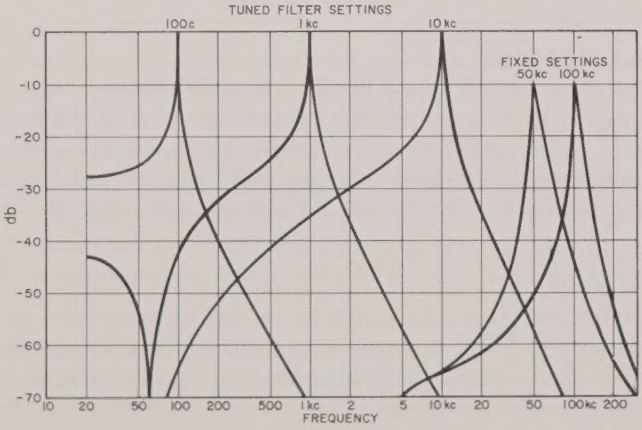


Figure 3. Typical filter characteristics of the Type 1232-A.

[1] A. E. Sanderson and R. G. Fulks, "A Simplified Noise Theory, and its Application to the Design of Low-Noise Amplifier," IRE Transaction on Audio, July-August, 1961.

sitions except FLAT and 20 - 200 C, another rejection filter reduces the response at 60 cps to greater than 60 db below peak response.

2.2 FREQUENCY-SELECTIVE AMPLIFIER.

This amplifier consists of three stages with negative feedback through a null network, which has its null at the desired operating frequency. Since there is negative feedback at all frequencies but the desired one, the over-all response peaks at this frequency and is roughly equivalent to that of a tuned circuit with a Q of about 20 (5% bandwidth). The unique feature of this null network is its one-potentiometer tuning. Many null networks require three variable elements, either ganged capacitors or ganged potentiometers. This leads to many problems in alignment and tracking the three elements to maintain a good null. The Hall null network[2] has a perfect null in theory for any position of the tuning potentiometer, and it is possible to cover a 10:1 tuning range with a 40-db exponential potentiometer. Tuning capacitors are switched to change ranges, maintaining the impedance level of the null network approximately constant for the three tuning ranges.

Since the 50-kc and 100-kc null networks need not be tunable, conventional twin-T null networks are used.

On the FLAT position of the range switch, all filters are switched out and the frequency response is flat to within ±3 db from 20 cps to 100 kc. The overall gain of the amplifier is reduced by 26 db to keep the noise level on the output meter equal to about 10 percent of full scale at maximum gain.

2.3 NULL NETWORK.

The Type 1232-A Tuned Amplifier and Null Detector uses an RC null network with only one variable component to adjust the frequency of the null. This avoids the use of ganged variable components, which must track closely to maintain stability when used in highly selective feedback amplifiers. The network (Figure 4), consisting of three-ter-

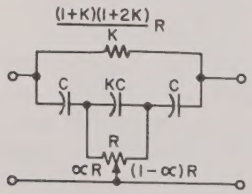


Figure 4. Null Circuit of the Type 1232-A Tuned Amplifier and Null Detector.

[2] Henry P. Hall, IRE Transactions on Circuit Theory, September 1955, Vol CT-2, No. 3, p 283; *General Radio Experimenter*, Vol 35, No. 7, July, 1961, p 8.

minal RC circuits, gives a complete null without being balanced against a voltage divider, and permits frequency adjustment with a single potentiometer. The tuning law for this circuit is

$$\omega_0 = \frac{1}{RC\sqrt{\alpha(1-\alpha)(1+2k)}}$$

In order to span a 10-to-1 logarithmic frequency range, the potentiometer must have an exponential characteristic of over 100 to 1.

The selectivity of the transfer admittance, $\frac{I_o}{E_{in}}$ (or y_{21}), is quite constant as the null frequency is changed. In order to use this characteristic, the network must be driven by and loaded by low impedances. Therefore, it is used in a feedback circuit with an amplifier having low input and output impedances and a transfer resistance $\frac{E_o}{I_{in}}$ (or a real z_{21}) that is chosen to give the desired selectivity. This combination provides a second-harmonic rejection of 34 db over each 10-to-1 frequency range.

2.4 AMPLIFIER-COMPRESSOR.

With the METER switch set to either linear position, the amplifier-compressor functions as a linear amplifier, driving the meter rectifier circuit and supplying the output terminals with about 1.4 volts for full-scale deflection of the meter. The LIN MAX SENS position provides full gain for very low-level applications. When maximum sensitivity is not required, use the LINEAR -20 DB position for a less noisy output. With this switch setting, the noise generated in the input and selective amplifier stages is attenuated. The dc supplied to the last transistor is sufficient to drive the output meter to full scale, but very little more, so that it is impossible to damage the meter by overdriving the amplifier.

For null detector use, the METER switch is thrown to LOG, effectively compressing the upper part of the meter scale. Two pairs of silicon diodes are switched in shunt with the collector resistors of two transistors to provide a nonlinear collector impedance. Owing to the voltage offset of the silicon diodes, the bottom 20 percent of the meter scale is virtually unaffected. A signal level corresponding to 100 percent deflection for linear response will drop to 50 percent for logarithmic response. An increase of 20 db increases the reading to 80 percent, and another 20 db raises the reading to 100 percent.

2.5 METER CIRCUIT.

The meter circuit uses a full-wave rectifier in order to double the ripple frequency that passes through the meter and thus to prevent the needle from vibrating visibly at 20 cps. Resistors are used in place of two of the rectifiers in the conventional full-wave bridge in order to linearize the relation between meter indication and signal level, and to minimize distortion. No dc amplification was incorporated into the meter circuit, so that there is no need for a dc zero adjustment on the front panel and no possibility of dc zero instability. High-impedance, crystal-type earphones can be connected to the output terminals.

Section 3
OPERATING PROCEDURE

3.1 USE AS AN AMPLIFIER OR PREAMPLIFIER.

To use the Type 1232-A or -AP Tuned Amplifier and Null Detector as an amplifier:

a. Connect the input signal to the INPUT connector of the Type 1232 or, if used, the Type 1232-P2. Adaptors for connectors other than Type 874 are available from General Radio (see table at rear of this manual). If the output impedance of the source of this signal is greater than 100 kΩ, set the switch on the Type 1232-P2, is used, to HIGH Z; otherwise set the switch to LOW Z.

NOTE

For connection to binding posts, use a Type 874-R34 Patch Cord. (Hum pickup is too great with a Type 874-Q2 Adaptor.)

b. Set the METER switch to LINEAR -20 DB (unless maximum sensitivity is required).

c. Set the FILTER FREQUENCY switch for the desired characteristic: FLAT, 20-200 C, 200 C - 2 KC, 2-20 KC, 50 KC, or 100 KC.

d. With the GAIN control, turn the instrument on and adjust the gain to the desired level. The total range of the GAIN control is 120 db, and attenuation in db is roughly proportional to the rotation angle of the control knob.

e. The OUTPUT terminals may be connected to an oscilloscope or headphones. The red binding post is high, the black binding post is ground.

The high sensitivity of this instrument permits its use as a preamplifier for transducer outputs or oscilloscope input.

3.2 USE AS A NULL DETECTOR FOR BRIDGE BALANCING.

To use this instrument as a detector for bridge measurements:

a. Connect the INPUT terminals of the Type 1232-A or -AP to the DETECTOR terminals of the bridge as in paragraph 3.1, step a.

b. Set the METER switch to LOG.

c. Set the FILTER FREQUENCY and FILTER TUNING controls to the desired frequency.

d. With generator and unknown connected to the bridge, set the GAIN control of the Type 1232-A for approximately half-scale deflection of the output meter, and tune the FILTER TUNING control for maximum output.

The bridge balance can now be made in the conventional manner, readjustment of the GAIN control as balance is approached.

3.3 USE AS A DETECTOR-DEMODULATOR.

For the detection of modulated high-frequency signals, the Type 1232-A Amplifier and Null Detector can be used with the Type 874-VQ Voltmeter Detector. Sensitivity is approximately 100 μv full-scale up to about 2000 Mc. The crystal output of the Type 874-VQ Voltmeter Detector should be connected through a Type 874-R22A Patch Cord to the INPUT connector of the Type 1232-A. The FILTER FREQUENCY and FILTER TUNING controls should be set to the frequency of the modulation on the high-frequency signal.

3.4 USE IN AUDIO SPECTRUM ANALYSIS.

The tuned amplifier can be used as an audio-frequency wave analyzer with a sensitivity of 1 μv and a bandwidth of about 5 percent. For approximate measurements, the gain can be assumed to be constant with frequency. More accurate measurements can be obtained if the amplifier is first calibrated with a constant-amplitude, variable-frequency signal. The typical variation of peak response vs frequency is shown in Figure 5.

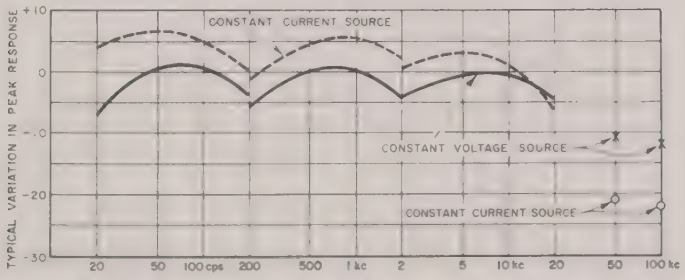


Figure 5. Typical variation in peak response with frequency for constant gain-control setting.

3.5 RF HETERODYNE RECEIVER.

By adding the accessory Type 1232-P1 RF Mixer ahead of the Type 1232-A and using an appropriate local-oscillator source, a sensitive well-shielded, heterodyne receiver with good harmonic rejection can be assembled. It has a frequency range from 70 kc to 10 Mc (good to 60 Mc by careful LO setting). When the frequency of the local oscillator is swept, the combination can be used for approximate spectrum analysis with an oscilloscope. It can also be used as a sensitive level indicator in attenuation measurements.

Section 4
SERVICE AND MAINTENANCE

4.1 WARRANTY AND SERVICE.

We warrant that each new instrument manufactured and sold by us is free from defects in material and workmanship, and that, properly used, it will perform in full accordance with applicable specifications for a period of two years after original shipment. Any instrument or component that is found within the two-year period not to meet these standards after examination by our factory, Sales Engineering Office, or authorized repair agency personnel, will be repaired, or, at our option, replaced without charge, except for tubes or batteries that have given normal service.

The two-year warranty stated above attests the quality of materials and workmanship in our products. When difficulties do occur, our service engineers will assist in any way possible. If the difficulty cannot be eliminated by use of the following service instructions, please write or phone our Service Department, giving full information of the trouble and of steps taken to remedy it. Be sure to mention the serial and type numbers of the instrument.

Before returning an instrument to General Radio for service, please write to our Service Department or nearest Sales Engineering Office (see back cover), requesting a Returned Material Tag. Use of this tag will ensure proper handling and identification. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay.

4.2 REMOVAL OF COVER.

To open the instrument for access to transistors and components, loosen the two fluted captive screws at the rear of the instrument and slide the U-shaped dust cover away from the panel. All transistors and components are now accessible.

4.3 BATTERY REPLACEMENT.

The Type 1232-A Tuned Amplifier and Null Detector is powered by nine M72 mercury batteries (Mallory RM-4R or equivalent), which will last for over 1500 hours with normal use. For a simple check of the batteries, measure the dc voltage between anchor terminal 6 and ground. This should be 12 volts.

To replace the batteries, remove the cap (twist counterclockwise and pull out) on the right-hand side of the instrument under the M72 CELLS engraving. Batteries must be inserted with the positive (+) ends facing into the instrument. Allow clearance space in rack mounts. To remove batteries on rack-mounted equipment, insert thin rod through opposite panel and push. Or, tape cell stack together and leave 2-inches extra

4.4 INTERNAL NOISE.

4.4.1 Noise Indicated by Meter. At certain frequencies the sensitivity of the Type 1232-A Tuned Amplifier and Null Detector greatly exceeds the catalog specifications. With maximum gain at these frequencies, the noise generated by transistor Q100 normally causes large deflection of the output meter. For maximum useful gain, the GAIN control should be set low enough so that the noise level at the output is not greater than 10 percent of full scale.

For minimum sensitivity to hum pickup and stray fields, input connections must be shielded. Do not use an adaptor from the Type 874 INPUT connector to binding posts; use a shielded Type 874 cable.

If, with completely shielded input connections, the noise level of the Type 1232-A greatly exceeds the values given in Figure 6, the noise is probably caused by Q100. If it is necessary to replace this transistor, a replacement with a high β (beta) will usually give the lowest noise levels.

It is possible, but not likely, that Q101 will contribute significantly to the internal noise. If it is necessary to replace Q101, select a Type 2N169A transistor with a β greater than 60.

4.4.2 Noise From the Type 1232-P2. The equivalent noise sources of the Type 1232-AP with the FILTER FREQUENCY set to 100 c/s are a current source of less than 0.1 $\mu\mu$A and a voltage source of less than 0.3 μV. If the noise levels of the Type 1232 alone do not exceed the values of Figure 6, yet the Type 1232-AP will not meet the above specifications, replace the transistor in the Type 1232-P2.

4.4.3 Output Noise. Due to the large amount of amplification that follows the GAIN control there is always a small amount of noise present at the OUTPUT terminals. At minimum gain, and with the FILTER

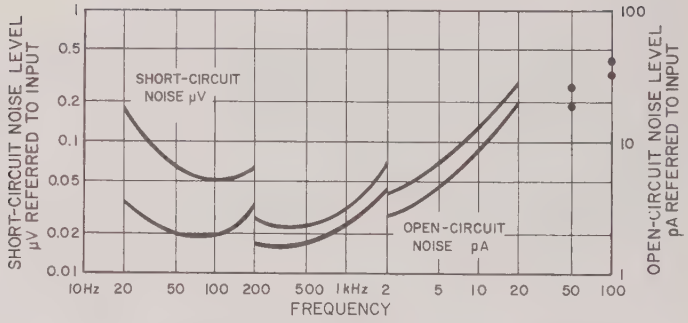


Figure 6. Typical noise levels as a function of frequency.

FREQUENCY control set to FLAT or with a FILTER FREQUENCY of 5 kc/s or lower, this noise should be less than 50 mv with the METER switch set to LIN MAX SENS and should cause no more than 1 percent deflection of the output meter. With the METER switch set to LINEAR -20 DB, this noise should be less than 5 mv.

If the noise is greater than 50 mv with minimum gain and LIN MAX SENS switch setting, the trouble is probably caused by Q200, Q201, or Q202. If this noise level is less than 50 mv and the noise with LINEAR -20 DB switch setting is greater than 5 mv, the faulty component is probably Q203, Q204, or Q205.

TABLE 2 VOLTAGES AND RESISTANCES

Transistor (Type)	Term.	Dc Volts To Ground	Ohms To Ground	Transistor (Type)	Term.	Dc Volts To Ground	Ohms To Ground
Q100 (TR-2/2N929)	C	7.8	222 k	Q202 (2N1395)	C	0	0
	E	3.6	220 k		E	3.5	11 k
	B	3.7	3.3 M		B	3.3	22 k
Q101 (TR-1/2N169A)	C	11.6	2.2 k	Q203 (TR-1/2N169A)	C	1.7	100 k
	E	7.7	40 k		E	0.4	4.7 k
	B	7.8	222 k		B	0.5	42 k
Q200 (TR-1/2N169A)	C	7.4	34 k	Q204 (TR-1/2N169A)	C	3.6	47 k
	E	3.6	33 k		E	1.6	10 k
	B	3.7	120 k		B	1.7	100 k
Q201 (2N1395)	C	3.3	22 k	Q205 (TR-1/2N169A)	C	7.2	4.4 k
	E	7.8	23 k		E	3.5	3.3 k
	B	7.4	34 k		B	3.6	47 k
Q101 of Type 1232-P2 (C6601A)	D	12.0	3.2 k				
	S	0.7 to 2.5	10 k				
	G	*	1 G				

* Impedance too high to permit measurement.

4.5 TRANSISTOR VOLTAGE AND RESISTANCE MEASUREMENTS.

Table 2 gives the normal voltage and resistance measurements from transistor terminals to ground. A deviation of 10 percent from any of these values is not necessarily abnormal.

1. Before making transistor voltage measurements, make sure that the battery voltage is approximately 12 volts (refer to paragraph 4.3). Turn the instrument on but leave the GAIN control counterclockwise, set the FILTER FREQUENCY, switch to FLAT and the METER switch to LINEAR. Measure voltage with a vacuum-tube voltmeter.

2. Before making resistance measurements, remove all the batteries and short-circuit anchor terminal 6 to ground. Remove all transistors. Set the GAIN control to OFF, the FILTER FREQUENCY switch to FLAT, and the METER switch to LINEAR.

4.6 TRIMMER-CAPACITOR ADJUSTMENT.

Normally, the factory-set trimmer capacitor adjustment (C202) will not require attention. However, adjustment may be necessary if transistor Q201, Q203, or Q204 is replaced. If the frequency response for the FLAT characteristic is outside the specified limits, adjust the trimmer capacitor as follows:

a. With the FILTER FREQUENCY switch set at FLAT and a 1-kc signal at the INPUT connector, adjust the GAIN control for a 5-db meter indication.

b. With the GAIN and FILTER FREQUENCY controls unchanged, apply a 100-kc signal (of the same amplitude as the 1-kc signal) to the INPUT connector and adjust the trimmer capacitor, C202, for a meter indication of 5 db. Check the frequency response below 100 kc to make sure it is within the specified limits.

c. With same settings, use continuously variable source to check that response is flat within ±3 db from 20 cps to 100 kc. Adjust with C 202, if necessary.

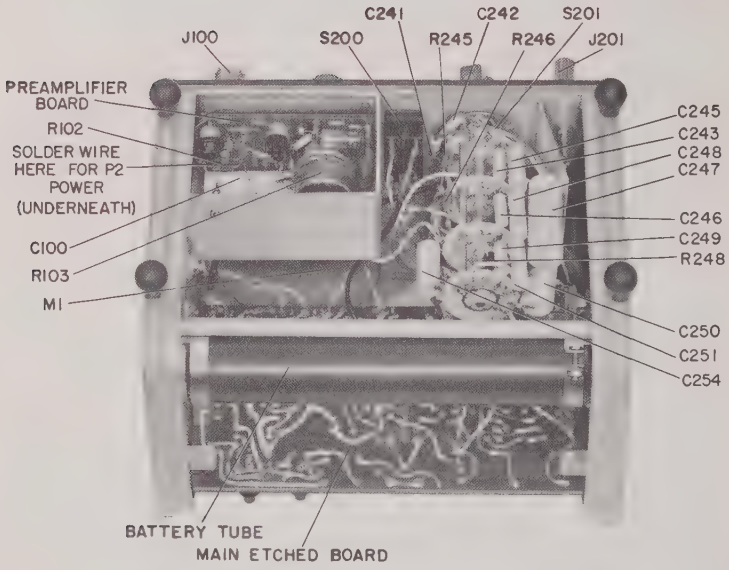


Figure 7. Bottom interior view of the Type 1232-A.

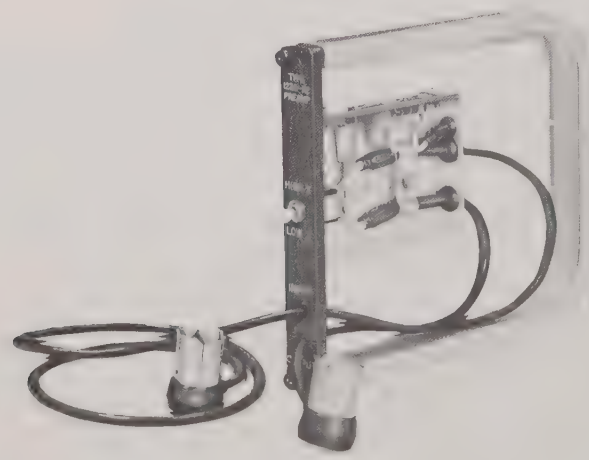


Figure 8. Interior of the Type 1232-P2.

PARTS LIST

REF NO.	DESCRIPTION	PART NO.
BT1	BATTERY, Drycell, mercury, type M72	8410-1372
C100	CAPACITOR, Plastic, 0.15μf ±10% 600v	4860-9400
C101	CAPACITOR, Electrolytic, 1μf ±20% 35dcwv	4450-4300
C102	CAPACITOR, Electrolytic, 100μf ±20% 15dcwv	4450-2800
C103	CAPACITOR, Electrolytic, 6.8μf ±20% 6dcwv	4450-4800
C104	CAPACITOR, Electrolytic, 4.7μf ±20% 10dcwv	4450-4700
C200	CAPACITOR, Electrolytic, 5μf 50dcwv	4450-3900
C201	CAPACITOR, Mica, 220pf ±10%	4620-1220
C202	CAPACITOR, Trimmer, 8-50pf ±5%	4910-1170
C204	CAPACITOR, Mica, 30pf ±10%	4620-0650
C205	CAPACITOR, Electrolytic, 200μf 6dcwv	4450-2610
C206	CAPACITOR, Mica, 100pf ±10%	4620-1000
C207	CAPACITOR, Electrolytic, 100μf 25dcwv	4450-2900
C208	CAPACITOR, Electrolytic, 100μf 25dcwv	4450-2900
C209	CAPACITOR, Plastic, 0.22μf ±10% 100dcwv	4860-7981
C210	CAPACITOR, Electrolytic, 10μf ±20% 20dcwv	4450-5100
C211	CAPACITOR, Ceramic, 680pf ±10% NM	4400-4980
C212	CAPACITOR, Electrolytic, 5μf 50dcwv	4450-3900
C213	CAPACITOR, Ceramic, 680pf ±10% NM	4400-4980
C214	CAPACITOR, Electrolytic, 5μf 50dcwv	4450-3900
C215	CAPACITOR, Electrolytic, 5μf 50dcwv	4450-3900
C216	CAPACITOR, Electrolytic, 5μf 50dcwv	4450-3900
C217	CAPACITOR, Electrolytic, 15μf 15dcwv	4450-3700
C218	CAPACITOR, Electrolytic, 5μf 50dcwv	4450-3900
C219	CAPACITOR, Plastic, 0.464μf ±2% 100dcwv	4860-7990
C220	CAPACITOR, Plastic, 0.464μf ±2% 100dcwv	4860-7990
C221	CAPACITOR, Plastic, 0.464μf ±2% 100dcwv	4860-7990
C222	CAPACITOR, Mica, 464pf ±1%	4710-0535
C223	CAPACITOR, Mica, 464pf ±1%	4710-0535
C224	CAPACITOR, Mica, 464pf ±1%	4710-0535
C225	CAPACITOR, Mica, 0.001μf ±1%	4710-0100
C226	CAPACITOR, Mica, 0.001μf ±1%	4710-0100
C227	CAPACITOR, Mica, 0.001μf ±1%	4710-0100
C230	CAPACITOR, Plastic, 0.01μf ±2% 100dcwv	4860-7650
C231	CAPACITOR, Plastic, 0.00681μf ±2% 200dcwv	4860-7505
C239	CAPACITOR, Electrolytic, 6.8μf ±20% 6dcwv	4450-4800
C240	CAPACITOR, Plastic, 0.015μf ±10% 100dcwv	4860-7655
C241	CAPACITOR, Plastic, 0.0022μf ±10% 200dcwv	4860-7329
C242	CAPACITOR, Plastic, 0.001μf ±10% 200dcwv	4860-7309
C243	CAPACITOR, Plastic, 0.00947 μf ±1% 100dcwv	4860-7553
C244	CAPACITOR, Plastic, 1μf ±1% 100dcwv	4860-8002
C245	CAPACITOR, Plastic, 0.1μf ±1% 100dcwv	4860-8251
C246	CAPACITOR, Plastic, 0.01μf ±1% 100dcwv	4860-7650
C247	CAPACITOR, Plastic, 1μf ±1% 100dcwv	4860-8002
C248	CAPACITOR, Plastic, 0.1μf ±1% 100dcwv	4860-8251
C249	CAPACITOR, Plastic, 0.01μf ±1% 100dcwv	4860-7650
C250	CAPACITOR, Plastic, 1μf ±1% 100dcwv	4860-8002
C251	CAPACITOR, Plastic, 0.1μf ±1% 100dcwv	4860-8251
C252	CAPACITOR, Plastic, 0.0033μf ±10% 200dcwv	4860-7359
C253	CAPACITOR, Plastic, 0.047μf ±10% 100dcwv	4860-8200
C254	CAPACITOR, Plastic, 0.22μf ±10% 100dcwv	4860-7981
C255	CAPACITOR, Electrolytic, 4.7μf ±20% 10dcwv	4450-4700
C256	CAPACITOR, Mica, 0.001μf ±10%	4660-6400
C257	CAPACITOR, Ceramic, 100 pf ±10%	4404-1108

PARTS LIST (cont)

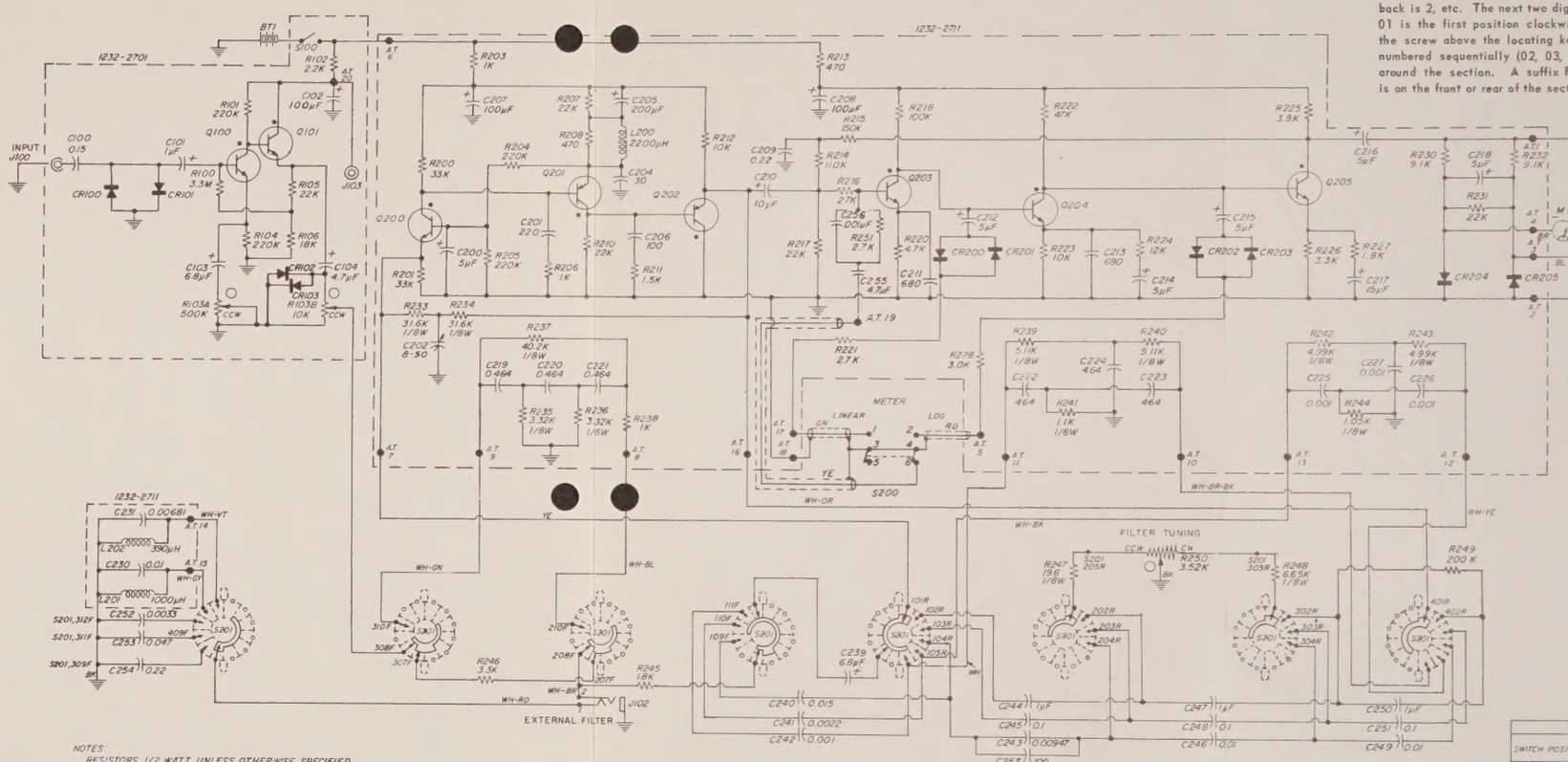
REF NO.	DESCRIPTION	ART NO.
CR100	SEMICONDUCTOR, Diode, type 1N3253	6081-1001
CR101	SEMICONDUCTOR, Diode, type 1N3253	6081-1001
CR102	SEMICONDUCTOR, Diode, type 1N3253	6081-1001
CR103	SEMICONDUCTOR, Diode, type 1N3253	6081-1001
CR200	SEMICONDUCTOR, Diode, type 1N3253	6081-1001
CR201	SEMICONDUCTOR, Diode, type 1N3253	6081-1001
CR202	SEMICONDUCTOR, Diode, type 1N3253	6081-1001
CR203	SEMICONDUCTOR, Diode, type 1N 3253	6081-1001
CR204	SEMICONDUCTOR, Diode, type 1N191	6082-1008
CR205	SEMICONDUCTOR, Diode, type 1N191	6082-1008
J100	CONNECTOR, Coaxial Locking, INPUT	0874-4181
J102	JACK, Phone, NC, EXTERNAL FILTER	4260-0400
J103	JACK, Pin, B+ for Type 1232-P2	4260-1010
J200	JACK, Binding post OUTPUT	4060-0100
J201	JACK, Binding post OUTPUT	4060-0100
L200	INDUCTOR, Choke, 2200μh ±10%	4300-6370
L201	INDUCTOR, Choke, 1000μh ±10%	4300-5000
L202	INDUCTOR, Choke, 390μh ±10%	4300-4390
M1	METER, 100μa	5730-1220
Q100	SEMICONDUCTOR, Transistor, type 2N929	8210-1002
Q101	SEMICONDUCTOR, Transistor, type 2N169A	8210-1692
Q200	SEMICONDUCTOR, Transistor, type 2N169A	8210-1692
Q201	SEMICONDUCTOR, Transistor , type 2N1395	8210-1045
Q202	SEMICONDUCTOR, Transistor, type 2N1395	8210-1045
Q203	SEMICONDUCTOR, Transistor, type 2N169A	8210-1692
Q204	SEMICONDUCTOR, Transistor, type 2N169A	8210-1692
Q205	SEMICONDUCTOR, Transistor, type 2N169A	8210-1692
R100	RESISTOR, Composition, 3.3M ±5% 1/2w	6100-5335
R101	RESISTOR, Composition, 220k ±5% 1/2w	6100-4225
R102	RESISTOR, Composition, 2.2k ±5% 1/2w	6100-2225
R103A	POTENTIOMETER, Dual 500k	1232-0400
R103B	POTENTIOMETER, Dual 10k	1232-0400
R104	RESISTOR, Composition, 220k ±5% 1/2w	6100-4225
R105	RESISTOR, Composition, 22k ±5% 1/2w	6100-3225
R106	RESISTOR, Composition, 18k ±5% 1/2w	6100-3185
R200	RESISTOR, Composition, 33k ±5% 1/2w	6100-3335
R201	RESISTOR, Composition, 33k ±5% 1/2w	6100-3335
R203	RESISTOR, Composition, 1k ±5% 1/2w	6100-2105
R204	RESISTOR, Composition, 220k ±5% 1/2w	6100-4225
R205	RESISTOR, Composition, 220k ±5% 1/2w	6100-4225
R206	RESISTOR, Composition, 1k ±5% 1/2w	6100-2105
R207	RESISTOR, Composition, 22k ±5% 1/2w	6100-3225
R208	RESISTOR, Composition, 470 ±5% 1/2w	6100-1475
R210	RESISTOR, Composition, 22k ±5% 1/2w	6100-3225
R211	RESISTOR, Composition, 1.5k ±5% 1/2w	6100-2155
R212	RESISTOR, Composition, 10k ±5% 1/2w	6100-3105
R213	RESISTOR, Composition, 470 ±5% 1/2w	6100-1475
R214	RESISTOR, Composition, 110k ±5% 1/2w	6100-4115
R215	RESISTOR, Composition, 150k ±5% 1/2w	6100-4155
R216	RESISTOR, Composition, 27k ±5% 1/2w	6100-3275
R217	RESISTOR, Composition, 22k ±5% 1/2w	6100-3225
R218	RESISTOR, Composition, 100k ±5% 1/2w	6100-4105

PARTS LIST (cont)

REF NO.	DESCRIPTION	PART NO.
R220	RESISTOR, Composition, 4.7k ±5% 1/2w	6100-2475
R221	RESISTOR, Composition, 2.7k ±5% 1/2w	6100-2275
R222	RESISTOR, Composition, 47k ±5% 1/2w	6100-3475
R223	RESISTOR, Composition, 10k ±5% 1/2w	6100-3105
R224	RESISTOR, Composition, 12k ±5% 1/2w	6100-3125
R225	RESISTOR, Composition, 3.9k ±5% 1/2w	6100-2395
R226	RESISTOR, Composition, 3.3k ±5% 1/2w	6100-2335
R227	RESISTOR, Composition, 1.8k ±5% 1/2w	6100-2185
R228	RESISTOR, Composition, 2.7k ±5% 1/2w	6100-2305
R230	RESISTOR, Composition, 9.1k ±5% 1/2w	6100-2915
R231	RESISTOR, Composition, 22k ±5% 1/2w	6100-3225
R232	RESISTOR, Composition, 9.1k ±5% 1/2w	6100-2915
R233	RESISTOR, Film 31.6k ±1% 1/8w	6250-2316
R234	RESISTOR, Film 31.6k ±1% 1/8w	6250-2316
R235	RESISTOR, Film 3.32k ±1% 1/8w	6250-1332
R236	RESISTOR, Film 3.32k ±1% 1/8w	6250-1332
R237	RESISTOR, Film 40.2k ±1% 1/8w	6250-2402
R238	RESISTOR, Composition, 1k ±5% 1/2w	6100-2105
R239	RESISTOR, Film 5.11k ±1% 1/8w	6250-1511
R240	RESISTOR, Film 5.11k ±1% 1/8w	6250-1511
R241	RESISTOR, Film 1.1k ±1% 1/8w	6250-1110
R242	RESISTOR, Film 4.99k ±1% 1/8w	6250-1499
R243	RESISTOR, Film 4.99k ±1% 1/8w	5250-1499
R244	RESISTOR, Film 1.05K ±1% 1/8w	6250-1105
R245	RESISTOR, Composition, 1.8k ±5% 1/2w	6100-2185
R246	RESISTOR, Composition, 3.3k ±5% 1/2w	6100-2335
R247	RESISTOR, Film 19.6 ±1% 1/2w	6450-9196
R248	RESISTOR, Film 6.65k ±1% 1/2w	6450-1665
R249	RESISTOR, Composition, 200k 1/2w ±5%	6100-4205
R250	POTENTIOMETER, Wire wound 3.25k 1/2w	0975-4040
R251	RESISTOR, Composition, 2.7kΩ ±5% 1/2w	6100-2275
S100	SWITCH, SPST (mounted on R103)	1232-0400
S200	SWITCH, DPST, toggle	7910-1300
S201	SWITCH, Rotary, wafer	7890-2410

PARTS LIST OF THE TYPE 1232-P2

REF NO.	DESCRIPTION	PART NO.
C101	CAPACITOR, Plastic, 0.001 µf ±200dcwv	4860-7309
R101	RESISTOR, Composition, 16Ω ±20% 1/2w	6100-8108
R102	RESISTOR, Composition, 10 kΩ ±5% 1/2w	6100-3105
R103	RESISTOR, 1 kΩ ±5% 1/2w	6100-2105
Q101	TRANSISTOR, Field Effect, Type C6601A	8210-1082
S101	SWITCH, Toggle, DPDT	7910-0791



NOTES:
RESISTORS 1/2 WATT UNLESS OTHERWISE SPECIFIED
RESISTANCE IN OHMS UNLESS OTHERWISE SPECIFIED
K = 1000 OHMS M = 1 MEGOHM
CAPACITANCE VALUES ONE AND OVER IN MICROMICROFARADS (PICOFARADS), LESS THAN ONE IN MICROFARADS, UNLESS OTHERWISE SPECIFIED.
○ KNOB CONTROL

Rotary switch sections are shown as viewed from the panel end of the shaft. The first digit of the contact number refers to the section. The section nearest the panel is 1, the next section back is 2, etc. The next two digits refer to the contact. Contact 01 is the first position clockwise from a strut screw (usually the screw above the locating key), and the other contacts are numbered sequentially (02, 03, 04, etc), proceeding clockwise around the section. A suffix F or R indicates that the contact is on the front or rear of the section, respectively.

Figure 9. Schematic diagram of the Type 1232-A Tuned Amplifier and Null Detector.

S201 SWITCHING DIAGRAM

SWITCH POSITION	SWITCH SECTIONS							
	1F	1R	2F	2R	3F	3R	4F	4R
FLAT	7-12	1-8	7-8		7-8			
20-200C	7-12	1-2-8	7-8	1-2	7-8	1-2	7-8	1-2
200C-2KC	7-12	1-3-8	8-10	1-3	8-10	1-3	7-9	1-3
2-20KC	7-9	1-4	8-10	1-4	8-10	1-4	7-10	1-4
50KC	7-10	1-5	8-10		8-10		7-11	1-5
100KC	7-11	1-6	8-10		8-10		7-12	1-6

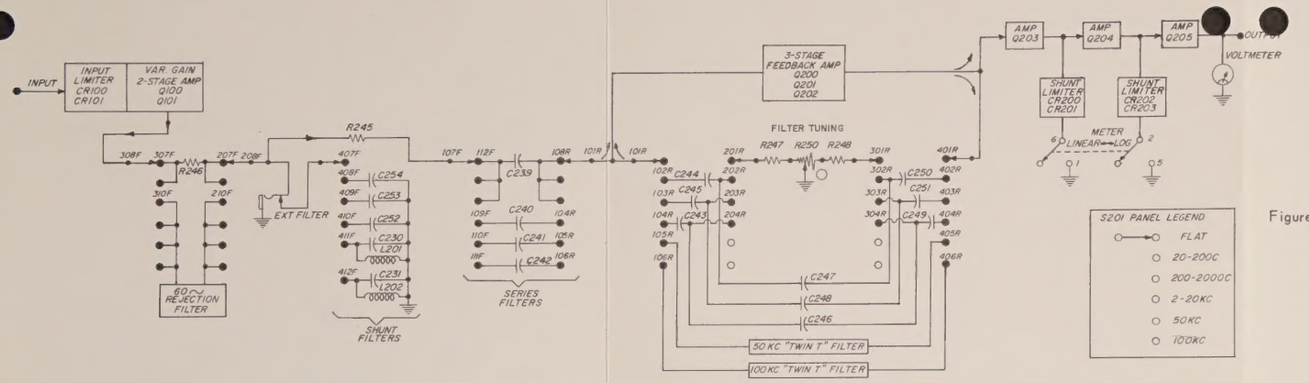


Figure 10. Block diagram of the Type 1232-A Tuned Amplifier and Null Detector.

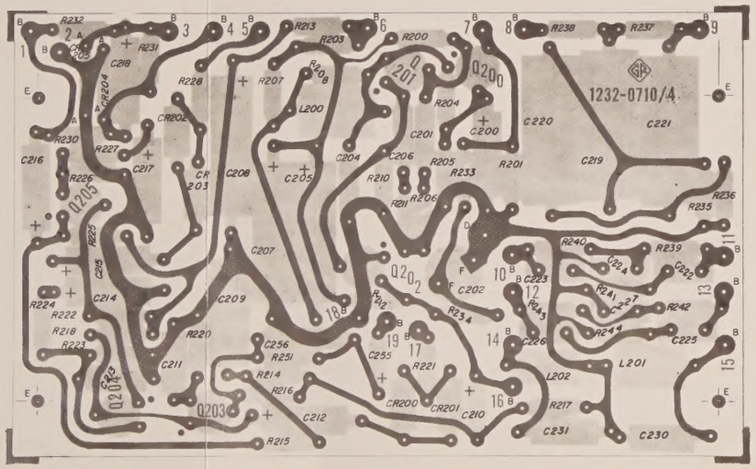


Figure 11. Etched Board Layout of the Type 1232-A Tuned Amplifier and Null Detector.

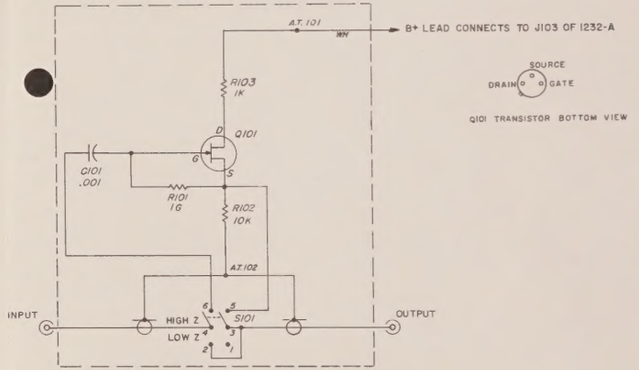


Figure 12. Schematic diagram of the Type 1232-P2 Preamplier.

TYPE 874 COAXIAL COMPONENTS

TYPE 874 CABLE CONNECTORS

APPLICABLE CABLE TYPES	CONNECTOR TYPE	CABLE	CABLE LOCKING	PANEL FLANGED	PANEL LOCKING	PANEL LOCKING RECESSED
50-Ohm	874-A2 RG-8A/U RG-9B/U RG-10A/U RG-87A/U RG-116/U RG-156/U RG-165/U RG-166/U RG-213/U RG-214/U RG-215/U RG-225/U RG-227/U RG-11A/U RG-12A/U RG-13A/U RG-63B/U RG-79B/U RG-89/U RG-144/U RG-146/U RG-149/U RG-216/U	-CA	-CLA	-PBA	-PLA	-PRLA
MDM-50-Ohm	874-A3 RG-29/U RG-55/U (Series) RG-58/U (Series) RG-141A/U RG-142A/U RG-159/U RG-223/U	-CSA	-CLSA	-PBSA	-PLSA	-PRLSA
50-Ohm	RG-59/U RG-62/U (Series) RG-71B/U RG-140/U RG-210/U	-C62A	-CL62A	-PB62A	-PL62A	-PRL62A
MDM-50-Ohm	RG-174/U RG-188/U RG-316/U	-C174A	-CL174A	-PB174A	-PL174A	-PRL174A
50-Ohm	RG-161/U RG-187/U RG-179/U					

Example: For a locking cable connector for RG-8A/U, order Type 874-CLRA.

TYPE 874 ADAPTORS

TO TYPE		874-
BNC	plug	QBJA
	jack	QBJL* QBPA
C	plug	QCJA
	jack	QCJL* QCP
HN	plug	QHJA
	jack	QHPA
LC	plug	QLJA QLPA
LT	plug	QLTJ
	jack	QLPT
Microdot	plug	QMDJ
	jack	QMDJL* QMDP
N	plug	QNJA
	jack	QNJL* QNP QNPL*
OSM/BRM	plug	QMMJ
	jack	QMMJL* QMMP QMMPL*
SC (Sandia)	plug	QSCJ
	jack	QSCJL* QSCP
TNC	plug	QTNJ
	jack	QTNJL* QTNP
UHF	plug	QUJ
	jack	QUJL* QUP
UHF 50-Ω Air Line	7/8-in. 1-5/8-in. 3-1/8-in.	QU1A QU2 QU3A

*Locking Type 874 Connector.

Example: To connect Type 874 to a type N jack, order Type 874-QNP.

CONNECTOR ASSEMBLY TOOLS

TYPE 874-	FUNCTION
TOK	Tool Kit
TOS6	Crimping Tool
TOS	Crimping Tool

OTHER COAXIAL ELEMENTS

TYPE 874-		TYPE 874-	
A2	50 Ω cable (low loss)	ML	component mount
A3	50 Ω cable	MB	coupling probe
D20L, D50L	20-, 50-cm adjustable stubs	MR, MRL	mixer-rectifier
EL, EL-L	90° ell	R30A, R20LA	patch cord, double shield
F185L, F500L, F1000L, F2000L, F4000L	185-Mc/s low-pass filter 500-Mc/s low-pass filter 1000-Mc/s low-pass filter 2000-Mc/s low-pass filter 4000-Mc/s low-pass filter	R22A, R22LA	patch cord, double shield
		R33, R34	patch cord, single shield
FBL	bias insertion unit	T, TL	tee
G3, G3L, G6, G6L, G10, G10L, G20, G20L, GAL, JR, K, KL, L10, L10L, L20, L20L, L30, L30L, LA1, LK10L, LK30L, LR, LTL	3-, 6-, 10-, and 20-dB attenuators adjustable attenuator rotary joint coupling capacitor 10-, 20-, and 30-cm rigid air lines 33-58 cm adjustable line constant-Z adjustable lines radiating line trombone constant-Z line	TPD, TPDL	power divider
		U	U-line section
		UBL	balun
		VCL	variable capacitor
		VI	voltmeter indicator
		VQ, VQL	voltmeter detector
		VR, VRL	voltmeter rectifier
		W100	100-Ω termination
		W200	200-Ω termination
		W50B, W50BL	50-Ω termination
		WN, WNS, WNL, WO, WOS, WOL	short-circuit terminations open-circuit terminations
		X	insertion unit
		XL	series inductor
		Y	cliplock
		Z	stand

MISCELLANEOUS COAXIAL CONNECTORS

CONNECTOR TYPE	TYPE NO.	USED WITH
Basic	874-B	50-ohm Air Line
Basic Locking	874-BBL	50-ohm Air Line
Panel Locking	874-PLT	Wire Lead
Panel Locking Recessed	874-PRLT	Wire Lead
Panel Locking Feedthrough	874-PFL	Type 874 Patch Cords

L suffix indicates locking Type 874 Connector.

FOR COMPLETE DETAILS, REFER TO THE GENERAL RADIO CATALOG.

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